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Contents

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Thoughtful Words

Scientists need to probe deeper for Nature's secrets if mankind is to conquer hunger and disease. It is my belief that research biologists must dig below present levels of understanding in order to fully comprehend the actual nature and behavior of living things.

Until now, biochemistry has occupied itself chiefly with molecules. I am profoundly convinced that to get to the bottom of things we must descend one dimension lower—to the dimension of the electron.

Electronic energy may hold the secret of the most important and complicated biological processes. For example, it has been found recently that all the chemical substances known to produce cancer are capable of giving off one electron. We have reason to believe that this electron, given off by carcinogens, is actually involved in the production of cancer.

It is in basic research such as this that we may find the solution to the great political problems of our age. They are intimately linked to the production of foodstuffs.

Much of the instability of the world is due to the fact that mankind is divided into two camps. In the smaller camp, the life span of the members is cut short by overeating, while in the larger camp the life span is cut short by starvation.

If we want to improve on the production and utilization of foodstuffs, we must first penetrate into the secrets of that very complex machine which we call the living organism.

All progress of our age can be traced back to progress in basic understanding of Nature, so one of the most important problems of any government must be the promotion of the understanding of this basic and fundamental research.

Curiosity is the driving force behind the genius of such scientific pioneers as Newton, Lavoisier, and Einstein; liberty is the air which it respires.

(Highlights from a USDA Graduate School lecture by Dr. Albert Szent Gyorgyi. pioneer research biologist and Nobel Prize winner, director of the Institute of Muscle Research, Marine Biological Laboratory, Woods Hole, Mass.)

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In 1926, winter oats were grown mainly in shaded area (bottom) of map. Because of increased hardiness they are now a safe crop at the northern extreme of white area.

WINTER OATS ARE MOVING NORTH

Increased hardiness of test selections indicates the safe production area can be extended more

■ The northern frontier for consistent profitable production of winter oats has been extended several hundred miles since 1926. That's when USDA and State scientists joined forces to increase hardiness of this valuable cereal crop.

Certain varieties now survive winter conditions at least 33 percent better than those grown a third of a century ago. And even greater hardiness of test selections indicates that production is destined farther north of where it's now considered safe.

In addition, acreage sown to winter oats has more than doubled in the last 30 years—due mainly to higher levels of hardiness and increased use of winter oats for pasturage in the South.

Interest in expanding winter oat culture has good basis. A successful variety is superior to spring-sown oats in yield and weight per bushel. Winter oats develop and ripen early—thus escaping some of

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WINTER OATS ARE MOVING NORTH

(*Continued*)

the spring oat production hazards such as hot weather, diseases, insects, and storms. Winter varieties are an excellent pasture crop—nutritious and palatable.

In 1926, F. A. Coffman, ARS oat agronomist at the Agricultural Research Center, Beltsville, Md., established the Uniform Winter Hardiness Nursery to serve as a central clearing house for advances in hardiness-breeding research at experiment stations.

Objectives of the Nursery are to: (1) evaluate the hardiness of new winter-oat selections developed at cooperating experiment stations; and (2) determine hardiness the oats need to survive differing climatic conditions. Annual progress reports from the Nursery are of great value to cooperating scientists developing and testing new hardy selections.

Success of this effort is indicated in the Nursery's records. For example, Winter Turf, in 1926 considered America's most winter-hardy variety, ranked 31st of 36 entries in 1960. And Wintok, ranking 1st from 1940 to 1957, moved down to 9th place among 1959 entries.

Top seven winter-hardy selections this year resulted from crosses by Coffman in 1951. Work is continuing to determine their agronomic suitability. And researchers are attempting to correct any evident deficiencies such as low yield, weak straw, poor kernel quality, and disease susceptibility.

Research progress is expected to be faster

Two recent trends in winter-hardiness research are expected to accelerate future progress. These trends are an expansion and improvement in the use of artificial testing facilities to shorten field-testing, and an increase in basic research on the physiochemical changes in the plant when it hardens.

E. J. Kinbacher, ARS plant physiologist at the Cornell University Agricultural Experiment Station, Ithaca, N.Y., improved artificial freezing facilities for rapidly screening hardy breeding material.

He constructed a hardening room, with a working temperature range of 35 to 45° F., and a freezing chamber with a range of −4 to 30° F. A thermostat maintains the desired temperature within ±1° F.

To test the unit, Kinbacher exposed standard winter-hardy oats to controlled freezing and compared the outcome with several years of field results from the same varieties. Good correlations between controlled and field freezing were obtained when 4-week-old seedlings were hardened 1 week at 38° F., frozen 24 hours at 17 to 19° F., thawed 24 hours at 38° F., and scored for injury 1 week after the freeze.

Kinbacher is also investigating the physiochemical components of changes within the plant that make it hardy. In cooperative studies with State scientists, he has shown that winter hardiness is not one characteristic, but several. It is ability to survive various stresses such as drouth, low temperature, frost heaving, snow, and ice cover that may confront the plant singly or in combination.

His studies show that 4-week-old winter-oat seedlings harden to cold when exposed to 38° F. for an extended period. The plants also become hardened to heat when exposed to a series of treatments at 100° F. Previous work by Coffman shows that plants hardened to heat or cold are resistant to both extremes in temperature.

Cell dehydration protects plants from cold

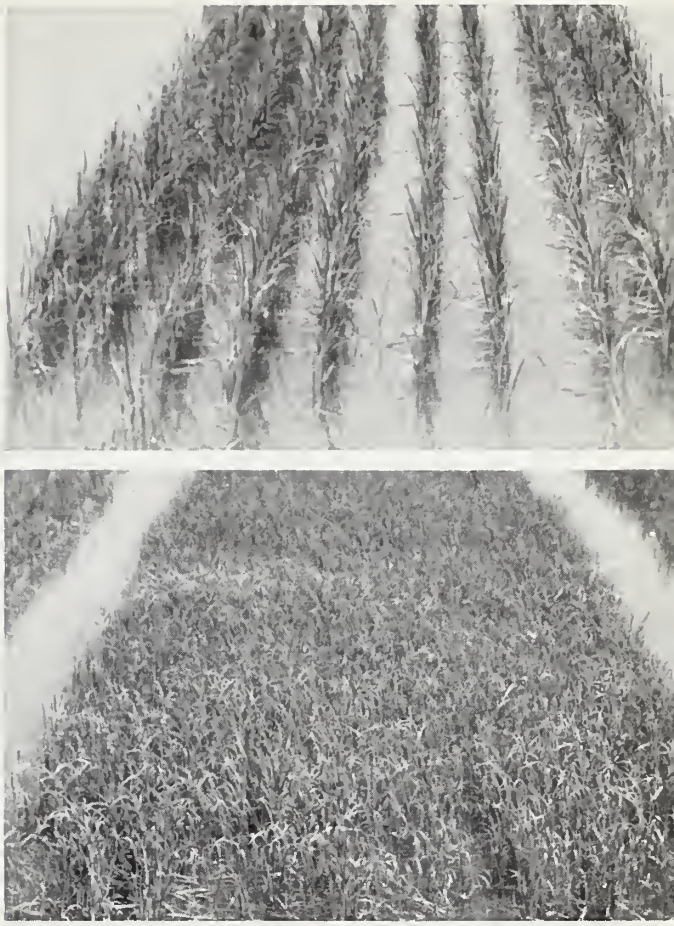
Other workers found that cold injury is caused by formation of ice within plant tissue. If ice forms within the cells, they are killed. It has been suggested that cold hardening produces changes which hinder ice formation within the cells. Instead, ice crystals form in the minute spaces (intercellular areas) between the cells. These ice crystals grow by pulling water from the cells to the intercellular spaces, thus dehydrating the cells. A winter-hardy plant can tolerate extensive dehydration in cold weather and, during thaws, regain moisture from the intercellular spaces.

Kinbacher believes that protein changes constitute the key factors in hardening of plant cells. He is investigating the possibility that amino acids—building blocks of protein—may trigger hardening. ☆

Kinbacher puts new oat selections in freezing room to harden them artificially and test survival rate.

It knocked out up to 90 percent of our most bothersome weed in rice

New Herbicide Controls Barnyard Grass



Rice field (above) sprayed with new herbicide at the rate of 4 pounds per acre is about free of barnyard grass. But the weed flourishes in the unsprayed rice field (right).

■ A chemical that has never before been used as an herbicide controls barnyard grass, our most troublesome weed in rice production.

Greenhouse experiments reveal that the new herbicide—3.4-dichloropropionanilide—controls barnyard grass without significant injury to rice—even when applied at 16 pounds per acre, 4 times the rate required for weed control. Best control is obtained when barnyard grass reaches the second to third leaf stage of growth and the chemical is applied at the rate of 4 pounds per acre. Preemergence treatment is ineffective, USDA researchers report.

In 1959 and 1960 field investigations, the chemical—applied as a postemergence spray at rates of 1, 2, and 4 pounds per acre—gave 75, 80, and 90 percent control, respectively, of barnyard grass.

May be approved for 1961 use

The chemical, however, isn't yet commercially available but may have Federal approval for use as an herbicide on a limited basis in 1961.

Studies of the chemical for barnyard grass control were conducted by ARS agronomists. R. J. Smith, Jr., worked in cooperation with the Arkansas Agricultural Experiment Station, Stuttgart, and K. L. Viste in cooperation with the California Agricultural Experiment Station at Biggs.

At present, CIPC [isopropyl N-(3-chlorophenyl) carbamate] is recommended in Arkansas for barnyard grass control in rice. Smith, who pioneered development of CIPC for this use, says the other chemical may have distinct advantages over CIPC.

Applied at 6 pounds per acre, CIPC controls the weed, but when used at 10 or 12 pounds per acre may cause rice damage. Rice must be drill-seeded at uniform depths to avoid damage from CIPC. There are no special seeding or water management requirements if 3,4-dichloropropionanilide is used. And because of its low toxicity, there are no critical handling precautions to be observed.

Smith found that 3,4-dichloropropionanilide is not a residual herbicide. And because of the compound's low residual activity, a single application is effective only 3 to 4 weeks. In some cases, effective control is needed 6 to 8 weeks.

Effective period was extended

To extend the time of the herbicide's effectiveness, Smith combined 3,4-dichloropropionanilide with CIPC or amaben (3-amino 2,5-dichlorobenzoic acid). Either of these residual chemicals, used at one-third the normal rate, in combination with the new chemical lengthened the effective control period—without adding the limitations of CIPC or amaben when used alone at higher rates.☆

AFTER KLAMATH WEED . . . WHAT?

Scientists are trying to find how to return forages to some Western ranges where other weeds compete

■ How can rangelands be re-established with productive forage plants following control of klamath weed?

This question applies to thousands of acres in the West now being cleared of klamath weed by the introduced beetles *Chrysolina gemellata* and *C. hyperica* (AGR. RES., July 1955, p. 5; and September 1958, p. 15). On much of the land, native forage plants are coming back and providing better grazing for livestock. In some of the areas, however, klamath weed is being replaced by other weed species that are equally competitive with good forage plants.

Dalmatian toadflax is one of the worst competitors in eastern Washington. Very little is known about this weed except that it develops a vigorous underground root system and is a prolific seed producer. There is no satisfactory method of control, especially of widespread infestations. Some success has been reported with fall applications of 2 to 3 pounds of chlorate-borate mixture per 100 square feet, but this treatment is far too costly for other than small patches or isolated plants.

More information is necessary

Research indicates that many forage grasses are suitable for production on western rangelands, if ways can be found to reduce or eliminate competing vegetation. This, in turn, requires a more complete understanding of the ecological relationships of plant populations competing for soil, water, and sunlight.

In the fall of 1957, USDA and the Washington Agricultural Experiment Station at Pullman began cooperative experiments to learn how desirable forage species behave in competition with dalmatian toadflax and klamath weed under various growing conditions.

Range conservationist D. H. Gates and research agronomist W. C. Robocker of ARS selected two experimental sites in the ponderosa pine-bluebunch wheatgrass area of eastern Washington. One site contained a heavy infestation of klamath weed with an undergrowth of annual lotus and cheatgrass. The other experimental site was similar, except that it was completely free of klamath weed.

Eight forages were seeded

Eight adapted forage grasses were seeded in cultivated and noncultivated plots at both sites. (Grasses seeded were Canada bluegrass, hard fescue, orchardgrass, tall wheatgrass, Primar slender wheatgrass, intermediate wheatgrass, Nordan crested wheatgrass, and Whitmar beardless wheatgrass.) Then dalmatian toadflax seed was broadcast over half of each plot.

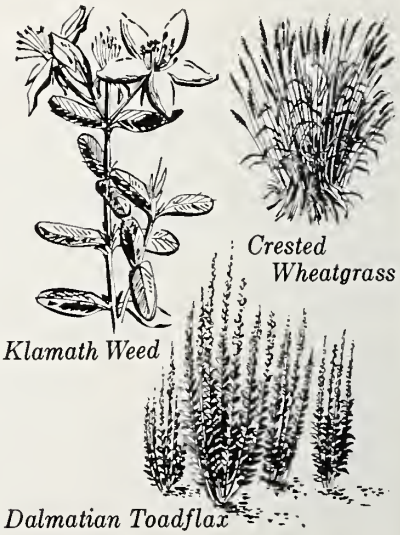
The grasses and the toadflax germinated and came up on cultivated plots at both sites. If any seedlings of toadflax emerged on the noncultivated plots, they were choked out the first year by competition from other plants. The researchers think this may mean that dalmatian toadflax is unable to establish itself in heavy stands of competing vegetation.

Acceptable stands of all the seeded grasses are now established on the cultivated plots. (A cold, open winter during 1958–59 killed many of the seedlings.) The stands vary from 12 plants of slender, intermediate, and crested wheatgrass to 3 plants of beardless and tall wheatgrass per 6 feet of row.

Cultivation has reduced the klamath weed by about two thirds. Also, beetles have been active throughout the period and, during last spring's feeding cycle, completely stripped live plants of new foliage. The weeds may not be able to survive such severe damage.

Dalmatian toadflax is firmly established on all the cultivated plots, but the stand is four times as heavy on the experimental site that contained no klamath weed as it is on the infested site. This suggests that klamath weed may create soil conditions that inhibit later establishment of dalmatian toadflax.

Thus far, the newly established forage grasses and weed species apparently have had little or no adverse affect on each other. Whether the desirable or the undesirable species finally win the race for survival will be determined only when each species is able to exert its full competitive affect on the total plant population. ☆



STRIP CROPPING FOR EXTRA MOISTURE

Sorghum stubble catches, spreads blowing snow. It provides more water for Central Plains farms

■ Central Plains farmers can use "grow-your-own" fences and retention traps to utilize snow blowing off wheat fields and provide additional moisture for crops, recent studies show.

Two simple strip-cropping techniques, designed by ARS soil scientists B. W. Greb and A. L. Black, use sorghum stubble to trap and spread snow over fields—stopping it from blowing into fence rows and ditches.

These techniques are a step forward in USDA-State efforts to make more efficient use of limited water supplies in semiarid regions of the Great Plains. The work is being done at Akron, Colo., in cooperation with the Colorado Agricultural Experiment Station.

The *snow-trapping* design consists of strips of continuous sorghum spaced at width ratios of 1 to 2 or 1 to 3 with a wheat-fallow rotation. On large acreages, the scientists suggest that 12 rows of sorghum (totaling 36 to 42 feet in width) be planted at intervals of 120 feet of wheat or fallow. The sorghum stubble remaining after harvest catches snow blowing off the wheat and becomes a self-feeding moisture supply for the following year's sorghum crop.

In typical high-velocity snowstorms that deposit 1 to 4 inches of level snow, the sorghum stubble traps as much as 10 to 12 inches. The scientists say snow crystals in the stubble break down to a sandlike texture, resulting in a higher concentration of water in the drifts than in loose, level snow.

Snow spreading is accomplished by planting parallel double rows of sorghum at intervals of 50 to 150 feet across the field. (The intervals can be varied to fit the needs of different sized equipment used in planting and harvesting wheat.) The sorghum is drilled in June each fallow year at regular seeding rates. After the heads are harvested, the stubble is left standing as a natural snow fence. This breaks the speed of blowing snow so that large amounts are deposited, and become directly available as moisture to the wheat crop.

Use of soil moisture by the growing sorghum leaves a slight temporary water deficiency for the first one or two rows of wheat adjacent to the sorghum stubble, but this is usually corrected by later snow deposits. ☆

Sorghum stubble "snow-fence" cuts the speed of blowing snow, causes it to spread over planted wheat area.

This 28-foot strip of sorghum stubble traps snow blowing off the adjacent 60-foot wheat strip to supply moisture needed for growing sorghum the following season.

Mechanization is the way to achieve more efficiency—and lower costs

Machines to Harvest Cherries

■ Tart red cherries may be a delight to consumers. But harvesting them is a big headache to growers.

The cherries are small and handpicking is slow, tedious work. It takes about 10 times as many man-hours to pick a ton of cherries as it does to pick a ton of apples, peaches, or pears. The season is short. Per-worker yield is small. And many pickers are needed.

But try and get them. Migrant pickers are scarce and expensive. In fact, about half the cost of producing cherries is in the harvesting. And costs are sure to go higher if human pickers do the work.

What's the answer? Mechanization, of course. It's the only logical way to take the headache out of harvesting tart red cherries.

Working toward this, agricultural engineers and horticulturists of USDA and the Michigan Agricultural Experiment Station at East Lansing devised equipment and methods to: (1) Reduce the needed number of pickers; (2) lower picking costs; and (3) help maintain on-the-tree fruit quality.

Various types of shaking and collecting equipment and methods were tried during 3 seasons. In general, studies showed that mechanization saves time, money, and labor.

A tractor-mounted, hydraulically activated shaker (it has a boom with a claw at the end) removed 95 percent of the cherries from trees. The cherries left on the trees were undersized and lacked color and maturity.

Several types of lightweight rectangular or semicircular folding canvas units were designed to catch the cherries. And various combinations of handling equipment were developed.

The journey from tree to tin via the mechanized route didn't damage the cherries, provided the equipment was carefully used. Mechanical harvesting along with proper handling of the fruit in water gave best quality fruit. The water is used for moving cherries from orchard to cannery to prevent injury (AGR. RES., June 1954, p. 19; February 1955, p. 14).

Total costs of harvesting varied from ½ to over 2½ cents a pound, depending on size of crop and work speed. Considering conditions existing in many orchards, mechanical harvesting should enable 7 men to do the work of 33 handpickers—and cut harvesting costs in half.

We don't have *all* the answers yet on a completely foolproof way to mechanically harvest tart red cherries. But studies so far show that the equipment and methods developed are practical and satisfactory. Continuing research will undoubtedly improve them.

Effectiveness of mechanization depends on several factors. Some of these are structure, spacing, and size of trees, yield, terrain of the orchards, equipment and handling methods, and management. ☆

Tractor-mounted boom shaker removes cherries, caught by circular collecting unit (above). Fruit then goes into trough (right), now replaced by two smaller ones.

. . . and Plums

■ Here's a dividend for Michigan growers of tart red cherries who also produce Stanley Prune plums. Most of the equipment for harvesting the cherries can be used on the Stanley plum picked for processing.

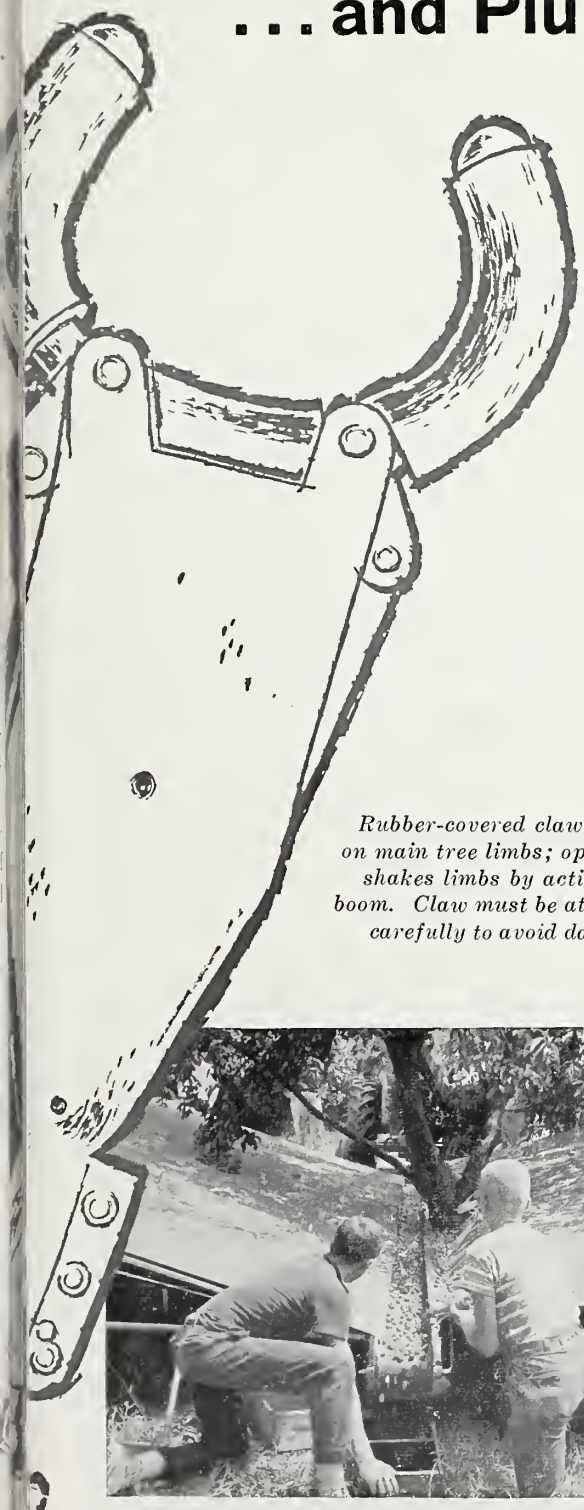
Such procedure is well suited to mechanical harvesting, because these fruits mature at different times in Michigan. The equipment might prove useful for harvesting other tree fruits. For example, shakers have been used successfully to harvest prunes in the West.

In Michigan, the ARS and State researchers economically used the boom-type shaker to remove 93 to 99 percent of the Stanley Prune plums from trees. depending on maturity of the fruit and tree shape. Trees were harvested at an average rate of over 10 an hour. (More than 80 could be harvested in an 8-hour day.) Average yield was slightly over 5 bushels per tree.

Each member of a five-man crew was paid $1.20 per hour in the 1958–59 studies, so labor costs were $6 an hour. Per-bushel costs were about 12 cents ($6 divided by 51 bushels picked per hour). This is a saving of 23 cents per bushel, compared to the 35 cents a bushel normally paid in Michigan for hand-picking plums. Per-day savings amount to more than $90, assuming the crew picks 408 bushels in an 8-hour day.

When quality evaluations were made in the orchards and processing plant, mechanically picked plums compared favorably with hand-picked fruit.

If Michigan growers own cherry harvesting equipment costing $3,000 to $4,000 and use it for Stanley Prune plum harvesting, savings will help pay overhead costs for the machines. Growers who don't own equipment may be able to lease it or have their plums custom-picked. ☆



Rubber-covered claw closes on main tree limbs; operator shakes limbs by activating boom. Claw must be attached carefully to avoid damage.

Hand-cranked conveyor attached to lower edge of a collecting unit enables workers to move cherries so they can be transferred to lugs.

Cherries can also be transferred directly from conveyor to large water-filled tanks and taken to the processing plant on trucks. Such handling preserves fruit quality.

Surprising development:

THE CHICKEN-TURKEY HYBRID

Hybrids weighed slightly over a half pound at 4 weeks. Weight is between that of 4-week-old chicks and poults.

■ Research in parthenogenesis has led unexpectedly to chicken-turkey hybrids—representing the first success in such crosses on record.

USDA poultry husbandman M. W. Olsen says the first hybrids appeared in experiments aimed at increasing the incidence of parthenogenetic embryos in turkey eggs. Olsen used unmated turkey hens artificially inseminated with semen from chickens.

Parthenogenesis, long known in lower forms of animal life, is the spontaneous development of embryonic tissue. It was discovered in turkey eggs by the ARS scientist in 1953. In attempts to determine reasons for this phenomenon and its relationship to genetics, he has used various means to increase or decrease parthenogenesis in different lines of turkeys and chickens.

Although the chicken-turkey hybrids do not represent the parthenogenetic development expected, they are a combination of birds of two widely separated families. Such crossing has long been regarded highly improbable. In past attempts to cross these fowls, scientists found some advanced and natural embryonic development of hybrids in eggs, but failed to hatch live birds.

The hybrids (hatched and unhatched) resembled chicks more than turkey poults. Each had the color markings, short heavy legs, and fully feathered neck of the chicken parent, and the white skin of the turkey parent. All hybrids had flattened, cushion-type combs (minus spikes). Appendages such as snoods, wattles, and earlobes were missing. Advanced hybrid embryos, including those hatched, were male.

Commercial use not expected

No commercial value is foreseen for the hybrids, Olsen says. As might be expected in progeny from interfamily crosses, such birds lack vigor, tend to be malformed, and cannot reproduce. Some hybrids had crossed beaks, notched upper beaks, and curled tongues. All needed aid in hatching. They were hand raised, and usually force fed. ☆

WE'VE IMPROVED BRUCELLOSIS TESTING

■ An improvement in the method of pinpointing dairy herds affected with brucellosis is resulting in substantial savings of time and labor in the State-USDA campaign to eradicate the disease.

ARS veterinarian O. J. Hummon improved the method by changing the type of sample taken for the milk ring test. Instead of sampling fresh deliveries at the milk plant, samples are drawn from the same bottle that supplies milk for butterfat tests there.

The milk ring test detects milk samples containing evidence of brucellosis. A positive reaction to the test means that the herd the milk came from is suspected of containing infected animals. Blood tests are then conducted on the herd to detect carriers.

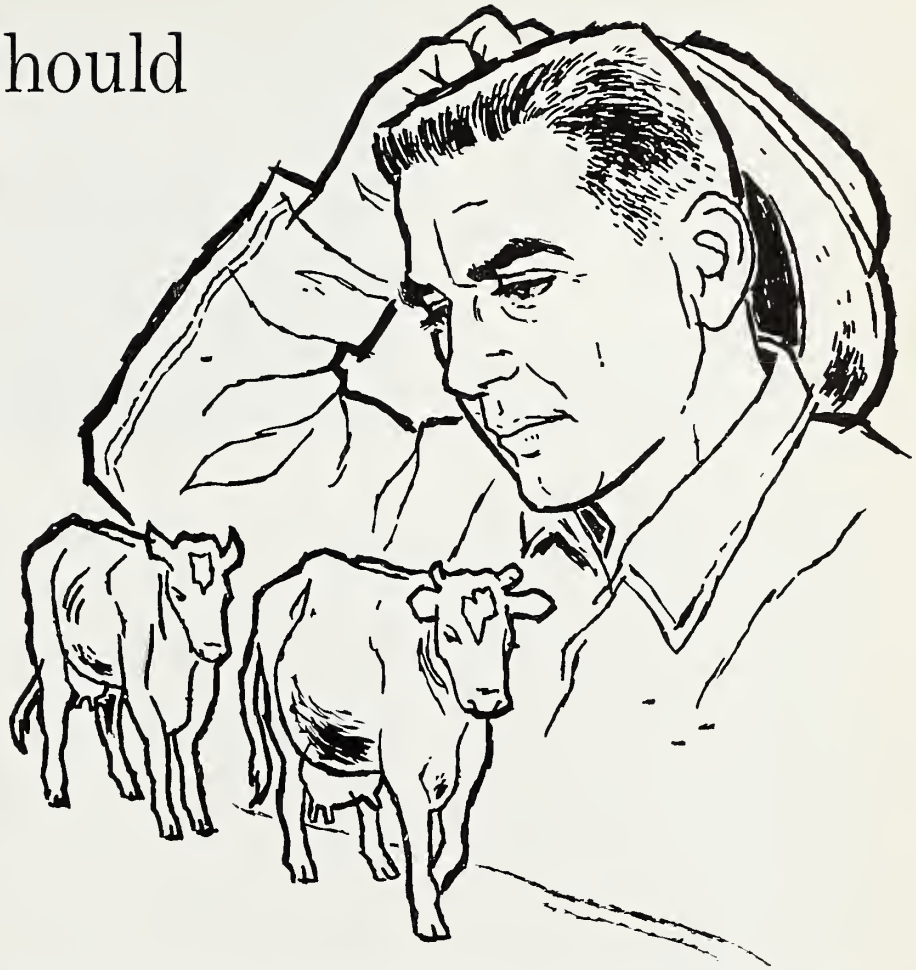
Samples drawn from butterfat test bottles can be handled much faster than those from fresh milk. Hummon estimates a potential saving of 50 percent in collection and laboratory work time. Records are more accurate, plant routine isn't upset, and more flexible scheduling of tests is possible.

For example, technicians don't have to revisit plants to collect samples from dairymen who do not deliver milk every day. This is because each bottle from which the sample is drawn contains milk from several deliveries of the producer.

With the incidence of brucellosis declining each year, greater efforts must be made to detect remaining centers of infection. Through the savings effected by using this new procedure, many States have been able to increase the frequency of tests from 2 to 3 times yearly. This additional surveillance makes it possible to move more rapidly toward eradication. ☆

Which One Should He Cull?

Answer: It's wise to sell low-producing cows and keep their daughters, if the sire has been proved superior



■ Milk production by daughters of low-producing cows will rise to herd average in only a few generations—if the sire is a good, progeny-tested animal.

This effect from breeding cows to good sires was shown in a recently completed long-term Holstein-Friesian breeding experiment at USDA's Agricultural Research Center, Beltsville, Md. The demonstration was possible because all of the daughters in the herd were raised, regardless of their appearance or potential value.

On the basis of the finding, ARS dairy scientist M. H. Fohrman advises keeping the daughters of low-producing cows and proved sires. No real benefit to herd production seems to result from culling these daughters. But, it's wise to cull their low-performing mothers, he says.

"Culled" herd produced most

Fohrman estimated herd production that would have been possible in the study, had low-producing cows and their descendants been culled. Twenty-one cows produced less than 425 pounds of butterfat during each of their best years. Culling their daughters would have removed 176 cows that averaged 661 pounds of butterfat a year. The 215 cows that would have remained in the herd averaged 651 pounds of butterfat annually. So the theoretically-culled herd actually outproduced the remaining animals.

In addition, records show that—even when proved bulls are used—highest producing cows don't always have the highest producing daughters. On the average, daughters of high-producing cows gave more milk than daughters of low-producing cows in the herd. But the range of production was practically the same.

The research was conducted on 8 generations of unculled, unselected cows. Only sires were selected. Use of these proved bulls resulted in rapid improvement in butterfat production for the first 5 generations.

After that, production climbed at a much slower rate. The herd's yearly butterfat production increased from an average of 530 pounds per cow to 703 pounds by the 5th generation, but increased to only 711 pounds in the last 3 generations.

Experiments are continuing

The Holsteins at Beltsville are among the highest producing unculled cows in the world, and experiments are underway to see if further improvements are possible.

Some of the cows are being mated, through artificial insemination, to the best proved Holsteins in the United States and Canada. In another part of this experiment, the best sires of other breeds are being used to find out if crossbreeding will increase production.☆

Water easily washes the new linseed oil-in-water paints from brushes and rollers.

LINSEED OIL-IN-WATER PAINTS FOR OUTSIDE USE

■ Linseed oil-in-water emulsion paints, for testing on *exterior* surfaces, have been made in recent experiments at USDA's Northern utilization laboratory at Peoria, Ill.

"With information gained in this research it appears feasible to develop a satisfactory linseed oil-in-water emulsion paint," says J. C. Cowan, Oilseed Crops Laboratory chief there. "It will, however, take considerable time and testing to establish the merits of these paints and to improve them for consumer use."

During evaluations, ARS chemists observed that many of the test paints have desirable characteristics of resin-emulsion and conventional linseed-oil type exterior paints.

Even though the new paints can be diluted with water, they resist water within 15 minutes after application and dry sufficiently in 30 minutes to permit repainting. Water easily washes the paints from brushes and rollers. The paints adhere well to chalking surfaces and have good covering qualities. They pour and flow easily, and do not readily form lap marks. Some of the paints (containing zinc oxide) remained stable on the shelf more than 46 weeks, according to the researchers.

Zinc oxide is used in exterior oil paints as a pigment, to control chalking, and to resist damage by mildew and ultraviolet light. But zinc oxide tends to make oil-in-water emulsions unstable. It can make paints become too thick to use or cause them to change into water-in-oil emulsions that cannot be diluted with water.

Earlier, the instability of emulsion paints containing practical amounts of zinc oxide was considered one of the greatest difficulties to overcome. Progress in this is indicated by development of new specialized emulsifiers (from linseed oil fatty acids) by W. L. Kubie. A. W. Schwab and J. A. Stolp used the emulsifiers to produce paints that have remained stable since they were made in November 1959. H. M. Teeter, project leader, says emulsions are being sought that will remain stable in paints an ideal 4 years.

A linseed oil-in-water emulsion paint may be a necessity if the oil is to continue competing with synthetics in the paint industry. In the U.S., use of linseed oil in paint has declined from 2.2 to 1.2 pounds per gallon in the last 20 years. Synthetic emulsions are now competing with linseed oil in its major area of use—exterior paints for wood. Ease of application and cleanup, such as water-washing of brushes, make emulsion paints especially attractive to do-it-yourself painters.

Member companies of the National Flaxseed Processors' Association are cooperating in the research at Peoria. In related work, research contractors are conducting fundamental studies of linseed oil emulsions and evaluating emulsions made from modified linseed oil.☆

Modified Wheat Flour Strengthens Paper

■ Acid-modified wheat flour has proved equal in laboratory tests to commercial sizing material for imparting strength to paper.

Some papers, sized with modified flour, gained 43 percent in bursting strength, 20 percent in tensile strength, and 93 percent in folding endurance in tests at USDA's Northern utilization laboratory, Peoria, Ill.

Papers treated with modified flour size were comparable to papers treated with commercial sizes in brightness, opacity, freedom from discoloration, and other desirable properties. It is expected that the modified flour will perform satisfactorily in high-speed paper-making machines.

Scientists believe that if the modified flour is introduced into the paper-making industry, substantial new markets for wheat could develop. This interest in wheat flour is based on: (1) Availability of flour as a raw material in large quantities at relatively low cost; and (2) broad industrial potential of a material that combines starch and gluten, both valuable for adhesive qualities.

Successful chemical modification of wheat flour by

reacting it with ethylene or propylene oxide was first reported by ARS scientists in June 1959. It was found that the chemically modified flour mixes readily with water to form a free-flowing paste, a quality desirable in industrial paper making. Northern laboratory chemists also reported that such flour could be stored with a moisture content of 5 percent or less.

Acid modification is the latest development in efforts to adapt flour as a paper size. This dry process can be applied to chemically modified flours that were developed earlier.

Acid modification is carried out at low temperatures, and processing materials are inexpensive. Dry flour is treated 1 to 8 hours with small amounts of acid at 77 to 95° F. The product is dry-blended 2 hours with an acid neutralizer.☆

COATINGS THAT PROTECT AND DECORATE

■ Dialdehyde starch derivatives, potentially useful as protective and decorative coatings for glass, metal, or wood, have been prepared experimentally by USDA chemists.

Coatings formed from one of the derivatives have high resistance to boiling water and most organic solvents. They are the first example of dialdehyde starch's potential use, in the chemical industry, as a raw material for other chemicals. Previous research showed the direct adaptability of dialdehyde starch in industry—as a binder or cementing agent, as an additive to paper, and as a tanning agent for leather (AGR. RES., December 1957, p. 4).

The making of these films is the third major advance in applied research on this versatile starch derivative in less than 2 years. In June 1959, ARS researchers of the Northern utilization division, Peoria, Ill., announced an improvement in their process for economical production of dialdehyde starch. Last year, the scientists developed a process for adding it to paper pulp to increase wet strength of paper (AGR. RES., May 1960, p. 13).

In making the coating materials, the chemists first reacted dialdehyde starch with unsaturated alcohols in the presence of acidic catalysts—substances used to speed up a chemical reaction. The reaction involves a change in grouping of the atoms—from aldehyde to acetal groups with the addition of a resin-forming group on the molecule.

In evaluations, coatings of these resin-like acetals on glass tubes were cured in a forced-draft oven at 302° F. Then the coatings were tested for hardness and resistance to boiling water and chemicals.

The best film on glass resisted boiling water 10 hours before it failed. It was undamaged by acetone or dilute sulfuric acid after 30 days' immersion, or by ethyl alcohol after 14 days. It rated 64 in the Sward test for hardness—a standard by which plate glass has a rating of 100.

The acetal made by reacting dialdehyde starch with allyl alcohol, a colorless, pungent liquid, is soluble in some organic solvents such as acetone. In this form, it can be applied easily to glass, metal, and wood.

The reaction with allyl alcohol is carried out at 104° F. at atmospheric pressure. These conditions are favorable for industrial production. Yields of the acetals are good, and there are no byproducts.

Dialdehyde starch is made by oxidizing wheat, corn, or grain sorghum starch with periodic acid (a chemical obtained from iodine). Although the process was known for many years, the high cost of periodic acid prohibited its use commercially.

This difficulty was overcome when chemists and engineers at the Northern division laboratory developed a process for electrolytically regenerating periodic acid at low cost. This opened the way for producing dialdehyde starch economically.☆

After 10 hours in boiling water, new film (on test tube at right) isn't damaged. But the commercial films on other tubes weren't able to fully withstand boiling water.

MEAT FLAVORS FROM FAT . . . NOT LEAN

■ The distinctive flavors of beef and pork appear to come from the fat rather than the lean portions, report USDA chemists I. Hornstein and P. F. Crowe.

Extracts containing the flavor-giving substances of the *lean* beef and pork cuts have the same taste and aroma after heating and appear to be identical chemically. The *fatty* portions, however, have distinctive tastes and aromas associated with each kind of meat.

Results of this work will be used to improve flavor and aroma of canned and processed meats. An understanding of the chemical causes of flavor will also enable researchers to devise means of preserving flavors and aromas when meats are stored.

These studies are part of overall research by the ARS Eastern utilization division seeking objective chemical tests for determining meat flavor and aroma. Presently, researchers must use taste panels and similar subjective methods to determine this aspect of meat quality.

Beef fat, when heated in a vacuum to the boiling point of water, was described as having an apple-like aroma and, when heated in air, a deep-fat-fried aroma. Pork fat was described as smelling like cheese when heated in the vacuum and fried bacon when heated in air.

The two fats also differ chemically. Each has different types and concentrations of free fatty acids and carbonyl compounds. Because these and other chemical differences were found, the researchers attribute the distinctive flavors and aromas of beef and pork to the fatty portions. They also found that the free fatty acid and carbonyl concentrations increase as meat is heated. This change may partially account for the rich aroma of cooking meat.

Soaking lean meat in cold water, the workers discovered, leaves it tasteless and odorless. They concluded from this that the flavor-producing compounds were dissolved in the water. When the solutions were dried and analyzed, evidence pointed to amino acids, small polypeptides, and carbohydrates as the flavor carriers in lean portions of beef and pork.☆

TWO DIET PLANNING AIDS

■ How much should you weigh? What is the best way to change your weight, if you need to? And are you getting all the nutrients you need?

To help you answer these questions, USDA nutrition specialists in the ARS Institute of Home Economics prepared two new aids for planning diets. For weight watchers, there is Food and Your Weight (HG–74) by Louise Page and Lillian J. Fincher. You can get an idea of what your desirable weight might be by using the weight table included. Then you can estimate your energy needs (calories) by taking account of your activities and the number of calories you expend each day.

The second food-planning aid is Nutritive Value of Foods (HG–72). It gives values for protein, total fat and fatty acids, carbohydrates, calcium, iron, vitamin A, thiamine, riboflavin, niacin, ascorbic acid, water, and calories in about 500 foods commonly used in this country. Recommended daily dietary allowances and information on yield of cooked meat per pound of raw meat are also included.

If you need to change your weight you can do so by either adjusting the amount of food you eat, or your activities, or both. Where weight is to be controlled by diet—the most practical and effective way—the researchers suggest using a food plan such as the Daily Food Guide (Agr. Res., May 1958, p. 6) to be sure basic body needs for protein, vitamins, and minerals are supplied in each day's meals. Each food group includes foods of varying calorie content, and you can choose those that best meet your needs.

Diets—either high or low in calories—can be planned within the framework of family meals and customary foods. Dieters are more apt to continue on such meals, and they are easier for the homemaker to prepare.

Regular, but not necessarily strenuous, exercise can help control weight. For example, if you change one of your sitting hours to one of moderate activity, you will use 90 extra calories a day. In a year, if your diet remains the same, you may lose 9 pounds. If you shift a second sitting hour to active recreation you will use an additional 170 calories a day and, in a year, shed another 15 pounds, or a total of 24 pounds.☆

Associateships to be offered

Twenty-five promising young scientists will be offered associateships for advanced training, among highly qualified veteran scientists, by USDA and the National Academy of Sciences-National Research Council.

These research associates will be chosen about April 1 for a year's work at one of the 15 ARS Pioneering Research Laboratories. Research and training is available in entomology, biochemistry, genetics, microbiology, agricultural economics, mineral nutrition of plants, physical chemistry, microbiological chemistry, plant physiology, and plant virology. The Pioneering Research Laboratories are located at Albany, Calif.; Beltsville, Md.; Lafayette, Ind.; New Orleans, La.; Peoria, Ill.; Philadelphia, Pa.; and Washington, D.C.

Applications will be evaluated by a special board appointed by the NAS–NRC. Applicants must submit evidence of training equivalent to that represented by a Ph. D. of Sc. D. degree and demonstrate superior ability for creative research.

The salary, $8,955, will be paid by ARS. Recipients may not accept aid from another appointment, fellowship, or similar grant during the term of their associateship.

Applications for 1961–62 awards must be filed with the Fellowship Office, National Academy of Sciences-National Research Council, 2102 Constitution Avenue, N.W., Washington 25, D.C., by February 1.

Midway strawberry is available

Midway, a new high-yielding, red-stele-resistant, virus-free strawberry—developed cooperatively by USDA and the Maryland Agricultural Experiment Station—is commercially available from nurserymen.

The new variety is recommended by ARS scientists for test growing as a replacement for Fairland and Temple, which are resistant to red stele disease but not virus-free.

Midway is particularly suitable for soils of good moisture-holding capacity. It produces many runners foi matted rows 20 to 24 inches wide. Test plantings at the Agricultural Research Center, Beltsville, Md., and

Salisbury, Md., yielded nearly 500 24-quart crates of strawberries per acre. Satisfactory yields were obtained also in New Jersey, Pennsylvania, Ohio, Indiana, Massachusetts, Missouri, and eastern Washington.

The new variety, a cross of Dixieland and Temple, ripens late in the season and produces medium-large, deep-red berries with glossy surface, firm flesh and skin, and yellow seeds. It's slightly acid-flavored, has good dessert quality, and freezes well.

Midway plants are susceptible to leaf scorch and leaf spot. However, these diseases can be controlled with fungicide sprays.

Rootstocks to aid against decline

Six varieties of citrus rootstock resistant to burrowing nematodes have been found by USDA and the Florida Citrus Experiment Station.

Budwood and seed of the resistant varieties are being increased by nurserymen. Nursery trees on the resistant rootstock should be available to growers in 2 to 3 years.

Burrowing nematodes cause spreading decline—a condition resulting in drastically reduced fruit production, and devitalization of Florida citrus trees. Decline doesn't kill trees, but weakens new growth. This growth has profuse blooms but few leaves and fruit, and small fruit.

The six varieties of resistant rootstock were identified by ARS and Florida plant breeders as Rough Lemon A and B, Sanguine grosse ronde, Pineapple–156, Carrizo citrange, and Clone X. Scientists do not yet have evidence that the latter variety will grow productive trees, although the rootstock appears promising.

The varieties were selected from nearly 1,000 citrus varieties and relatives; 39 showed various degrees of resistance and were further tested in nematode-infested soils.

Spreading decline usually begins in a few trees and gradually infects oth-

ers as the burrowing nematodes—parasitic eelworms one-fortieth of an inch long—move through soil to feed on healthy trce roots.

About 11,000 acres of Florida citrus groves are infested with spreading decline. Since 1956, when screening for nematode resistance began, about $5 million has been spent to control the disorder.

Control consists of removing and burning infected trees, and treating soil with the nematocide DD (dichloropropane-dichloropropene).

Soil measuring technique improved

Understanding the relationship between soil particle size and the availability of water and nutrients is being

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aided by an improved method of measuring the surface area of soils.

Ability of a soil to hold water and nutrients depends largely on the surface area of particles in a given volume of soil. Fine soils, having a greater surface area, hold more water and nutrients than coarse soils.

ARS soil scientist C. A. Bower and his co-workers at the U.S. Salinity Laboratory, Riverside, Calif., modified a method of measuring the surface area of clay soils so it can be used on *any* soil. The original method was developed by soil scientist R. S. Dyal and chief scientist S. B. Hendricks of USDA's Mineral Nutrition Laboratory at Beltsville, Md.

Ethylene glycol coats soil particles with a layer one molecule thick. A dried soil sample is soaked with the chemical and the excess is removed in a vacuum chamber.

By weighing the amount of ethylene glycol held by the soil and calculating weight and size of the ethylene glycol molecule, scientists can determine surface area of the sample.

This measuring method is being used by scientists of other Federal and State agencies and by construction inspectors to ensure that the proper sizes of sand and gravel are used in concrete.

Tractors share much in progress

Modern tractors are responsible for a major share of the tremendous increase in farmer efficiency in recent years. A glance at data, compiled by USDA agricultural economists, tells the story of rapid, efficient mechanization on U.S. farms.

There were 5,160,000 tractors on our farms in 1959—a net increase of almost 2.7 million since 1945.

The biggest percentage increase was in garden tractors with less than 9-belt horsepower and drawbar capacity for one 12-inch plow. In 1941, there were about 10,000 on farms. This number exceeded 400,000 in 1959 and comprised 8 percent of the total on farms that year.

Tractors today are lighter in weight. In 1958, tractors with 22-drawbar horsepower had one-third the weight of similar horsepower tractors 50 years ago. Of wheel tractors in 1947, about 70 percent were

classified as general-purpose machines. Approximately 90 percent of them were of this type in 1958.

In 1959, more than a third of wheel tractors produced burned diesel fuel or LP gas. As recently as 1950, however, gasoline-powered tractors made up about 90 percent of the wheel tractors on farms.

How long do tractors last? The ARS study of 1927 to 1956 statistics indicates that their useful life averages 16 years. About two-thirds of the wheel tractors on farms in 1956 were less than 10 years old. Their average age was 9 years.

New wheats for 1961 production

Ottawa, Kaw, and Milam are new USDA-State developed varieties of hard red winter wheat being increased by seed growers for farm planting in the fall of 1961.

Ottawa is highly resistant to soilborne mosaic virus. It has good resistance to hessian fly, leaf rust, and stem rust (race 56), but is susceptible to stinking and loose smuts and streak mosaic. It shatters less than Pawnee, grows about as high, and is about or slightly more winter hardy than Ponca.

Kaw is early maturing and similar to Witchita but not as winter hardy. Kaw is resistant to leaf rust, and stinking smut, and partially resistant to stem rust (race 56). It is susceptible to streak mosaic, loose smut, soilborne mosaic, and the hessian fly.

Milam is relatively short, strong-strawed, and matures about 2 weeks later than Seabreeze and slightly earlier than Quanah or Atlas 66. It has outstanding resistance to stem rust and many races of leaf rust, and has more disease resistance than any variety now grown in south Texas for feed grain and pasture. It is not suited for growth north of the Austin-Temple area of Texas.

Ottawa was developed by ARS and the Kansas Agricultural Experiment Station, Kaw by ARS and the Kansas and Oklahoma stations, and Milam by ARS and the Texas station in cooperation with the Rockefeller Foundation.